

Appendix I: Toxicological Profiles of Arsenic, Chromium, Lead, Nickel, Selenium, and Thallium

Arsenic, chromium, lead, nickel, selenium, and thallium compounds are six toxic chemicals that are found in coal combustion waste (CCW). These chemicals are released from CCW into the environment through dust that is inhaled or settles onto soil and plants, and leachate or direct discharges that contaminate ground and surface water.¹ These toxic chemicals have significant health effects, including cancer, and can be fatal in some instances.

Arsenic is a metalloid that, when combined with oxygen, chlorine, and sulfur, is a human poison, and can result in death if ingested in large quantities. The International Agency for Research on Cancer (IARC) has classified inorganic arsenic as a carcinogen, and ingestion of arsenic may create an increased risk of skin, liver, bladder, and lung cancer. Smaller oral doses may cause individuals to experience “stomachache, nausea, vomiting, and diarrhea.” In addition, there is at least some research to suggest that inhalation or ingestion of arsenic may inhibit fetal development, causing “low birth weight, fetal malformations, and even fetal death.”

Agency for Toxic Substances & Disease Registry, Dep’t of Health & Human Services, CAS No. 7440-38-2, Public Health Statement: Arsenic (Aug. 2007), *available at* <http://www.atsdr.cdc.gov/toxprofiles/tp2-c1-b.pdf>.

Chromium is an element that occurs naturally, and is found in “rocks, animals, plants, and soil.” The IARC has classified chromium (VI), the most toxic form, as a carcinogen. “[I]nhalation of chromium (VI) has been shown to cause lung cancer.” Inhalation of chromium may also cause breathing problems, such as “asthma, cough, shortness of breath, [and] wheezing.” Ingestion of chromium (VI) may increase risk of stomach tumors.

Agency for Toxic Substances & Disease Registry, Dep’t of Health & Human Services, CAS No. 7440-47-3, Public Health Statement: Chromium (Sept. 2008), *available at* <http://www.atsdr.cdc.gov/toxprofiles/tp7-c1-b.pdf>.

Lead is a metal that impacts the nervous system when inhaled or swallowed, and can “severely damage the brain and kidneys,” potentially resulting in death. Children are especially vulnerable to the impacts of lead exposure, and “[a] child who swallows large amounts of lead may develop anemia, kidney damage, colic (severe “stomach ache”), muscle weakness, and brain damage, which ultimately can kill the child.” The IARC has stated that “inorganic lead is probably carcinogenic to humans” due to results from tests performed on laboratory animals.

Agency for Toxic Substances & Disease Registry, Dep’t of Health & Human Services, CAS No. 7439-92-1, Public Health Statement: Lead (Aug. 2007), *available at* <http://www.atsdr.cdc.gov/toxprofiles/tp13-c1-b.pdf>.

¹ See Office of Solid Waste, U.S. Env’tl. Prot. Agency, Technical Background Document for the Supplemental Report to Congress on Remaining Fossil Fuel Combustion Wastes: Ground-water Pathway Human Health Risk Assessment (June 5, 1998), *available at* http://www.epa.gov/osw/nonhaz/industrial/special/fossil/ffc2_395.pdf and Research Triangle Institute, Non-groundwater Pathways, Human Health and Ecological Risk Analysis for Fossil Fuel Combustion Phase 2 (FFC2) (June 5, 1998), *available at* <http://www.epa.gov/osw/nonhaz/industrial/special/fossil/ngwrsk1.pdf>.

Nickel is a metal that may cause “chronic bronchitis, reduced lung function, and cancer of the lung and nasal sinus” when inhaled at high concentrations. According to the IARC, “metallic nickels may possibly be carcinogenic to humans.” Although there are limited studies on the human health effects of nickel ingestion, swallowing high levels of nickel have been known to cause “lung disease in dogs and rats and to affect the stomach, blood, liver, kidneys, and immune system in rats and mice, as well as their reproduction and development.” Skin exposure may result in skin rashes such as hand eczema.

Agency for Toxic Substances & Disease Registry, Dep’t of Health & Human Services, CAS No. 7440-02-0, Public Health Statement: Nickel (Aug. 2005), *available at* <http://www.atsdr.cdc.gov/toxprofiles/tp15-c1-b.pdf>.

Selenium is an element that is often found in rocks “combined with sulfide minerals or with silver, copper, lead, and nickel minerals.” Inhalation of high amounts of selenium has been known to cause pulmonary edema and severe bronchitis in extreme cases. Dizziness and fatigue may also occur when selenium is inhaled. Ingestion of very high levels of some selenium compounds “can be life-threatening without immediate medical treatment,” and lower doses ingested over long periods of time can cause brittle hair, deformed nails, and loss of feeling in limbs. Skin exposure to selenium may cause skin rashes, swelling, and pain.

Agency for Toxic Substances & Disease Registry, Dep’t of Health & Human Services, CAS No. 7782-49-2, Public Health Statement: Selenium (Sept. 2003), *available at* <http://www.atsdr.cdc.gov/toxprofiles/tp92-c1-b.pdf>.

Thallium, a metal, may negatively impact the “nervous system, heart, liver, and kidney” and even cause death if large doses are ingested in a short amount of time. Less severe symptoms include “temporary hair loss, vomiting, and diarrhea.” Although there have been limited studies on long-term exposure to small amounts of this metal, thallium may cause death “from a dose as low as 1 gram.”

Agency for Toxic Substances & Disease Registry, Dep’t of Health & Human Services, CAS No. 44-28-0 (July 1992), *available at* <http://www.atsdr.cdc.gov/toxprofiles/tp54-c1.pdf>.